

# THE EFFECTS OF AIRCRAFT NOISE AND ROAD TRAFFIC NOISE ON READING COMPREHENSION AND ATTENTION: THE RANCH STUDY

C.Clark<sup>1</sup>, S.A. Stansfeld<sup>1</sup>, M.M.Haines<sup>1</sup>, M.Matheson<sup>1</sup>, B.Berry<sup>4</sup>, J.Head<sup>1</sup>, R.M. Cameron<sup>1</sup>, R. Asker<sup>1</sup>, I. Lopez-Barrio<sup>2</sup>, R.Martin<sup>2</sup>, P.Fischer<sup>3</sup>, I. van Kamp<sup>3</sup> & E. van Kempen<sup>3</sup>.  
<sup>1</sup>Queen Mary, University of London, UK, <sup>2</sup>CSIC, Madrid, Spain, <sup>3</sup>RIVM, Bilthoven, The Netherlands, <sup>4</sup>BEL, London

**Introduction** Previous studies have found an association between chronic noise exposure and reading comprehension (Haines et al 2001a, 2001b, Hygge et al, 2002). There is also some evidence to suggest that chronic noise exposure leads to deficits in sustained attention (Haines et al, 2001c), however this effect is not always found (Haines et al 2001b, Hygge et al 2002). Previous studies have tended to compare groups in high and low aircraft noise exposures and have not examined dose-effect relationships. Furthermore, most studies have examined the effects of aircraft noise and have omitted to examine road traffic noise and combinations of aircraft and road traffic noise.

The RANCH study is examining dose-effect relationships of aircraft noise, road traffic noise and combinations of aircraft and road traffic noise on children's health and cognition. As part of RANCH a field study was conducted to examine the association between chronic exposure to aircraft and road traffic noise, reading comprehension and sustained attention in 9-10 year old children in three European countries (the Netherlands, Spain and the United Kingdom). It was hypothesised that there would be a dose-effect relationship between exposure to noise (aircraft, road traffic and combinations of aircraft and road-traffic) and impairments in reading comprehension and sustained attention.

## Method

*Design* Children were selected to take part in the study on the basis of school noise exposure around airports in each of the three countries (Schiphol in the Netherlands, Madrid in Spain and Heathrow in the UK). In each country schools were sampled from a range of noise exposures (low to high levels of aircraft noise, low to high levels of road traffic noise and combinations thereof), so that dose-effect relationships could be examined. Schools were matched according to socio-economic status.

*Measures* Sustained attention was measured using an adaptation of the Toulouse Pieron test, a non-verbal test of attention. The test involves subjects searching rows of symbols for target symbols. Reading comprehension was measured using established, nationally standardised tests; in the UK the Suffolk reading scale (Hagley, 2002), in the Netherlands the CLIB test and in Spain the ECL-2. As these tests are standardised, comparisons can be made between the different countries. Information about socio-economic context variables such as mother's education and the employment status of the highest income earner were assessed by a parent questionnaire, which was completed by the child's mother where possible.

*Procedure* A total of 2940 children, aged 9-10 years took part in the study (UK n=1182, NL n=730, Spain n=1028). Testing was carried out under close supervision in the classroom at the schools.

*Analysis* Preliminary analyses of the pooled data from the UK, Netherlands and Spain were carried out using analysis of covariance with noise as a continuous variable. All analyses were initially adjusted for centre (Netherlands, Spain or UK) and subsequently adjusted for mother's

education (measured on a relative inequality index, scored between 0-1 (Kunst, 1998)) and for employment status of the highest income holder in the family (measured as a dichotomous variable, employed or not employed).

**Results** In preliminary analyses of pooled data from the UK, Netherlands and Spain, aircraft noise was associated with a significant impairment in reading comprehension in analysis of covariance adjusting for country, employment status and mother's education (Table 1). This effect was not found for road traffic noise exposure. No effects of either aircraft noise or road traffic noise were found for sustained attention.

Table 1: Cognitive outcomes and aircraft noise exposure; adjusted for centre, mother's education and employment status.

	B	Confidence Interval	p
Reading comprehension			
Centre adjusted	-.166	-.238 to -.093	.0001
Centre, mother's education adjusted	-.154	-.235 to -.073	.0001
Centre, employment adjusted	-.150	-.233 to -.073	.0001
Centre, mother's education, employment adjusted	-.143	-.266 to -.060	.0001

B=change in outcome score associated with 1dB change in noise.

**Discussion** These preliminary analyses suggest an effect of aircraft noise on reading comprehension. This is consistent with previous studies (Haines et al 2001a, 2001b, Hygge et al, 2002). There was no effect of road traffic noise on reading comprehension, suggesting that aircraft noise has a greater impact upon children's reading comprehension than road traffic noise. There was no effect of either aircraft or road traffic noise on sustained attention. This result is consistent with previous studies that have failed to find an effect of noise on sustained attention (Haines et al 2001b, Hygge et al 2002). Road traffic noise did not have an effect on either reading comprehension or sustained attention. This suggests that road traffic noise is less disruptive than aircraft noise, although it is possible that the levels of road traffic noise in the schools sampled were not high enough to evoke a response. Further analyses will clarify the dose-effect relationship between noise exposure, reading comprehension and sustained attention and will inform policies on children's noise exposure.

**Keywords:** Noise exposure, children, reading comprehension, attention

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